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Research Interests

My research interests include (1) understanding the ocean's role in the global climate system, (2) formulating physically and mathematically sound subgrid-scale parameterizations for ocean dynamics, especially those related to ocean mesoscale eddies, (3) developing robust and efficient numerical algorithms for ocean circulation models, (4) articulating the fundamentals of ocean climate models, and (5) studying methods for quantifying predictability and using these methods to understand climate variability.

Themes

An overall goal of my research and development work is to contribute to the evolution of ocean climate modeling into a rationally driven scientific endeavor. This, as well as my training in theoretical physics, motivates me to approach research from fundamental physical, mathematical, and numerical perspectives, and to present work in a pedagogical manner. More precisely, my work can be split into two main areas: the design, construction, and support of numerical ocean climate models, and the use and analysis of climate model simulations. There is a synergy between model building and model use, and such provides an underlying theme to my research.

Computer models that simulate the ocean are the main tool scientists use to address large-scale ocean climate questions. These questions have relevance over a broad range of issues, from curiosity driven research to policy relevant scenarios. My work has resulted in papers of notable impact, such as those focusing on subgrid-scale parameterizations. It has also led me to become the leader of the Modular Ocean Model (MOM) effort, where MOM is used by hundreds of ocean climate scientists worldwide. Finally, this work has motivated me to compose a monograph on the fundamentals of ocean climate models. This book aims to provide the modeling community, especially its students, with a thorough pedagogical discussion of what it takes to formulate and to build an ocean climate model.

My use of ocean climate models has thus far emphasized the large-scale circulation, especially that in the North Atlantic. Out of this work came the first systematic study of simulated North Atlantic predictability, as well as novel methods for quantifying climate predictability. I am presently involved in projects aiming to diagnose and understand differences between global climate simulations achieved with various high-end models. Understanding differences between model simulations, and providing methods for achieving systematic comparisons, is a critical and nontrivial goal of ocean climate modelers, especially as simulations become more widely used as the basis for government policy.

Leadership

I have been a leader in the Geophysical Fluid Dynamics Laboratory's (GFDL's) ocean climate modeling efforts since the late 1990's. This work has most prominently involved my providing intellectual and management leadership for the development of MOM, which has been used in GFDL's coupled earth system models. As leader of GFDL's Oceans and Climate Group between 2001-2005, I was responsible for developing research agendas for the group, as well as the recruitment of research scientists for sabbatical visits and/or for joining our staff. I also provide leadership in the international ocean climate science community as chair (since 2004) of the Clivar Working Group for Ocean Model Development. In both leadership roles, I have set up collaborative projects with national and international researchers. In particular, this collaborative effort has led to my taking a 10 month visit to CSIRO Marine and Atmospheric Research in Australia during 2005. This time abroad has strengthened the scientific interactions between Australian ocean scientists and GFDL.

Employment and Appointments

2006–present	**GFDL Ocean Model Development Team co-Leader**
2005	**Visiting Scientist, CSIRO Marine and Atmospheric Research, Hobart, Australia**
2001–2005	**GFDL Oceans and Climate Group Leader**
2001–2002	**GFDL Ocean Model Development Team co-Leader**
2000–2001	**GFDL Climate Model Development Team Leader**
2000–present	**GFDL Physical Scientist, Grade GS-14**
1997–2000	**GFDL Physical Scientist, Grade GS-13**
1996–1997	**GFDL Physical Scientist, Grade GS-12**
1995–1996	**GFDL Visiting Research Scientist**
1993–1995	**UCAR Global & Climate Change Fellow at Princeton University**
1988–1993	**University of Pennsylvania Physics Graduate Research Fellow**
1984–1986	**Louisiana State University Chemical Engineering Research Technician**

Education

1988–1993	**University of Pennsylvania** Doctoral student in theoretical physics (Ph.D. June 1993)	**Philadelphia, USA**
1987–1988	**University of Washington** Physics undergraduate student	**Seattle, USA**
1986–1987	**Northwestern University** Masters student in applied mathematics (M.S. June 1987)	**Evanston, USA**
1981–1986	**Louisiana State University** Undergraduate student in chemical engineering (B.S. June 1986)	**Baton Rouge, USA**

Oceanographic Cruises

1993	**Technical Assistant**: WOCE Line AR7W / Atlantic Circulation Experiment, Labrador Sea, *CCGS* Hudson (John Lazier, Chief Scientist)

Awards

2001	**NOAA/Oceanic and Atmospheric Research Outstanding Scientific Paper**
1999	**NOAA/Oceanic and Atmospheric Research Outstanding Scientific Paper**
1998	**NOAA/Oceanic and Atmospheric Research Employee of the Year**
1997	**NOAA/Environmental Research Laboratories Outstanding Scientific Paper**

Professional Societies and Committees

Member of the American Geophysical Union (since 1993)

Member of the American Meteorological Society (since 1993)

Co-author: Intergovernmental Panel on Climate Change-2001, sections on climate predictability (with Tim Palmer) and ocean climate modeling (with Peter Gent and Claus Böning)

Chair of the CLIVAR Working Group on Ocean Model Development (2005-present).

Co-chair (with Claus Böning) of the CLIVAR Working Group on Ocean Model Development (2004-2005).

Member of the World Climate Research Programme (WCRP) and World Ocean Circulation Experiment (WOCE) Working Group on Ocean Model Development (2000-2004).

Teaching experience and invited pedagogical lectures

Nov 2007	Six invited lectures: "Ocean Model Fundamentals" at the University of Tasmania, Australia.
Sep 2007	Two invited lectures on "Ocean Model Subgrid Scale Parameterizations" at the CKO International Summer School on Physical Oceanography. Les Diablerets, Switzerland.
Aug 2006	Two invited lectures on "Ocean Model Fundamentals" at the NSF summer school, "Modern Mathematical Methods in Physical Oceanography." Breckenridge, USA.
Oct 2004	Ten invited lectures: "Ocean Model Fundamentals," Indian Intensive School on Large-Scale Ocean Modelling. Bangalore, India.
Sep 2004	Three invited lectures: "Ocean Model Fundamentals," GODAE Summer School. La Londe Les Maures, France.
Jan 2001	Three invited lectures on Ocean Dynamics and Modeling. La Escuela de Verano de Universidad de Concepción, Chile.
Mar 1999	Two invited lectures on ocean and climate modeling at the Conference on Global Climate. Barcelona, Spain.
Autumn 1993	Co-Lecturer: Atmospheric and Oceanic Data Assimilation, Princeton University
1990–1993	Instructor: Undergraduate Physics Laboratory, University of Pennsylvania
1990–1993	Teaching Assistant: General Relativity and Quantum Field Theory, University of Pennsylvania

Key workshops

Aug 2007	Co-organizer of the CLIVAR workshop "Numerical Methods in Ocean Modelling." Bergen, Norway.
Nov 2005	Co-organizer of the CLIVAR workshop "Modelling the Southern Ocean." Hobart, Australia.
Jun 2004	Co-organizer of the CLIVAR workshop "Evaluating the Ocean Component of IPCC-Class Models." Princeton, USA.
May 2003	Invited lecturer for the workshop "Australian ocean climate modelling." Hobart, Australia.
May 2002	Invited lecturer for the workshop "German ocean climate modeling." Kiel, Germany.
Aug 2002	Co-organizer for the workshop "Z-coordinate Ocean Modeling." Massachusetts Institute of Technology, Cambridge, USA.
Nov 1999	Organizer for the workshop "Z-coordinate Ocean Modeling at GFDL, LANL, MIT, and NCAR." Princeton, USA.
Jul 1999	Co-chair (with Shoshiro Minobe) of the International Union of Geodesy and Geophysics Session on Ocean/Atmosphere Variability and Predictability. Birmingham, England.
Jan 1998	Student at the NATO Advanced Study Institute: Ocean Modeling and Parameterization. Les Houches, France.
Jan 1996	Student at the NATO Advanced Study Institute: Climate Variability and Predictability. Les Houches, France.
Jul 1994	Meeting of UCAR Global and Climate Change Fellows. Steamboat Springs, USA.
Jul 1992	Student at the Theoretical Advanced Study Institute: "From String Theory to Black Holes." Boulder, USA.
Jul 1991	Student at the High Energy Physics and Cosmology Summer School, Center for Theoretical Physics. Trieste, Italy.
Jun 1991	Student at the Theoretical Physics Summer School: "Particle Physics in the 1990's." Les Houches, France.

Journal publications

1. Effects in a climate model of slope tapering in neutral physics schemes, 2007: A. Gnanadesikan, **S.M. Griffies**, B.L. Samuels, *Ocean Modelling*, **16**, 1–16.

2. Algorithms for density, potential temperature, conservative temperature and freezing temperature of seawater, 2006: D. R. Jackett, T. J. McDougall, R. Feistel, D. G. Wright, and **S. M. Griffies**. *Journal of Atmospheric and Oceanic Technology*, **23**, 1709–1728.

3. GFDL's CM2 Global Coupled Climate Models-Part 2: The Baseline Ocean Simulation, 2006: A. Gnanadesikan, K.W. Dixon, **S.M. Griffies**, V. Balaji, J.A. Beesley, W.F. Cooke, T.L. Delworth, R. Gerdes, M.J. Harrison, I.M. Held, W.J. Hurlin, H.-C. Lee, Z. Liang, G. Nong, R.C. Pacanowski, A. Rosati, J. Russell, B.L. Samuels, S.M. Song, M.J. Spelman, R.J. Stouffer, C.O. Sweeney, G. Vecchi, M. Winton, A.T. Wittenberg, F. Zeng, and R. Zhang. *Journal of Climate*, **19**, 675–697.

4. GFDL's CM2 Global Coupled Climate Models-Part 1: Formulation and Simulation Characteristics, 2006: T.L. Delworth, A.J. Broccoli, A. Rosati, R.J. Stouffer, V. Balaji, J.A. Beeseley, W.F. Cooke, K.W. Dixon, J. Dunne, K.A. Dunne, J.W. Durachta, K.L. Findell, P. Ginoux, A. Gnanadesikan, C.T. Gordon, **S.M. Griffies**, R. Gudgel, M.J. Harrison, I.M. Held, R.S. Hemler, L.W. Horowitz, S.A. Klein, T.R. Knutson, P.J. Kushner, A.L. Langenhorst, H.-C. Lee, S.J. Lin, L. Lu, S.L. Malyshev, P.C. Milly, V. Ramaswamy, J. Russell, M.D. Schwarzkopf, E. Shevliakova, J. Sirutis, M.J. Spelman, W.F. Stern, M. Winton, A.T. Wittenberg, B. Wyman, F. Zeng, R. Zhang. *Journal of Climate*, **19**, 643–674.

5. Sensitivity of a global ocean model to increased run-off from Greenland, 2006: R. Gerdes, W.J. Hurlin, and **S.M. Griffies**, *Ocean Modelling*, **12**, 416–435.

6. Formulation of an ocean model for global climate simulations, 2005: **S.M. Griffies**, A. Gnanadesikan, K.W. Dixon, J.P. Dunne, R. Gerdes, M.J. Harrison, A. Rosati, J. Russell, B.L. Samuels, M.J. Spelman, M. Winton, R. Zhang. *Ocean Science*, **1**, 45–79.

7. Impacts of shortwave penetration depth on large-scale ocean circulation and heat transport, 2005: C. Sweeney, A. Gnanadesikan, **S. M. Griffies**, M. J. Harrison, A. J. Rosati, and B. L. Samuels. *Journal of Physical Oceanography*, **35**, 1103–1119.

8. Tracer Conservation with an Explicit Free Surface Method for Z-coordinate Ocean Models, 2001: **S.M. Griffies**, R.C. Pacanowski, M. Schmidt, and V. Balaji, *Monthly Weather Review*, **129**, 1081–1098.

9. Developments in Ocean Climate Modelling, 2000: **S.M. Griffies**, C. Böning, F.O. Bryan, E.P. Chassignet, R. Gerdes, H. Hasumi, A. Hirst, A.-M. Treguier, and D. Webb, *Ocean Modelling*, **2**, 123-192. **NOAA/Oceanic and Atmospheric Research Laboratories 2001 Outstanding Scientific Review Paper Award**.

10. Biharmonic friction with a Smagorinsky-like viscosity for use in large-scale eddy-permitting ocean models, 2000: **S.M. Griffies** and R. W. Hallberg. *Monthly Weather Review*, **128**, 2935–2946.

11. Spurious diapycnal mixing associated with advection in a z-coordinate ocean model, 2000: **S.M. Griffies**, R. C. Pacanowski, and R. W. Hallberg. *Monthly Weather Review*, **128**, 538–564.

12. A conceptual framework for predictability studies, 1999: T. Schneider and **S.M. Griffies**. *Journal of Climate*, **12**, 3133-3155.

13. The Gent-McWilliams Skew-Flux, 1998: **S.M. Griffies**, *Journal of Physical Oceanography*, **28**, 831-841.

14. Isoneutral diffusion in a z-coordinate ocean model, 1998: **S.M. Griffies**, A. Gnanadesikan, R. C. Pacanowski, V. Larichev, J. K. Dukowicz, and R. D. Smith, *Journal of Physical Oceanography*, **28**, 805–830. **NOAA/Oceanic and Atmospheric Research Laboratories 1999 Outstanding Scientific Paper Award**.

15. A Predictability Study of Simulated North Atlantic Multidecadal Variability, 1997: **S.M. Griffies** and K. Bryan, *Climate Dynamics*, **13**, 459–488.

16. Predictability of North Atlantic Multidecadal Climate Variability, 1997: **S.M. Griffies** and K. Bryan, *Science* **275**, 181–184. **NOAA/Environmental Research Laboratories 1997 Outstanding Scientific Paper Award**.

17. Reply to Comment on "Instability of the Thermohaline Circulation with Respect to Mixed Boundary Conditions", 1996: J. R. Toggweiler, E. Tziperman, Y. Feliks, K. Bryan, **S.M. Griffies**, and B. Samuels, *Journal of Physical Oceanography*, **26**, 1106–1110.

18. A Linear Thermohaline Oscillator Driven by Stochastic Atmospheric Forcing, 1995: **S.M. Griffies** and E. Tziperman, *Journal of Climate*, **8**, 2440–2453.

Books, chapters, manuals, and unrefereed articles

1. Ocean Modelling with MOM, 2007: **S.M. Griffies**, M.J. Harrison, R.C. Pacanowski, and A. Rosati, *CLIVAR Exchanges*, Newsletter of the Climate Variability and Predictability Programme. Issue No. **42** (Volume 12 No 3), pages 3–5.

2. **Elements of mom4p1**, 2007: **S.M. Griffies**, NOAA/Geophysical Fluid Dynamics Laboratory Technical Report No. 6. Princeton, USA. 385 pages.

3. Design considerations for Coordinated Ocean-ice Reference Experiments, 2007: **S.M. Griffies**, Claus Böning, and Anne Marie Treguier, *Flux News*, a publication of the WCRP Working Group on Surface Fluxes, Issue **3**, pages 3–5.

4. Some ocean model fundamentals, 2005: **S.M. Griffies**, in **Ocean Weather Forecasting: an Integrated View of Oceanography**, edited by E.P. Chassignet and J. Verron, pages 19–73. Springer Publishing.

5. **Fundamentals of Ocean Climate Models**, 2004: **S.M. Griffies**. *Princeton University Press*. Princeton, USA. 518+xxxiv pages.

6. **A Technical Guide to MOM4**, 2004: **S.M. Griffies**, M. J. Harrrison, R.C. Pacanowski, and A. Rosati, NOAA/Geophysical Fluid Dynamics Laboratory Technical Report No. 5. Princeton, USA. 337 pages.

7. An Introduction to Linear Predictability Analysis, 2003: **S.M. Griffies**. In **Global Climate: Current Research and Uncertaintites in the Climate System**. X. Rodo and R. A. Comín, editors. Springer.

8. An Introduction to Ocean Climate Modeling. 2003: **S.M. Griffies**, In **Global Climate: Current Research and Uncertaintites in the Climate System**. X. Rodo and R. A. Comín, editors. Springer.

9. Physical climate processes and feedbacks. In **Climate Change 2001: Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change**, 2001: T.F. Stocker, G. K. C. Clarke, H. Le Treut, R. S. Lindzen, V. P. Meleshko, R. K. Mugara, T. N. Palmer, R. T. Pierrehumbert, P. J. Sellers, K. E. Trenberth, J. Willebrand, R. B. Alley, O. E. Anisimov, C. Appenzeller, R. G. Barry, J. J. Bates, R. Bindschadler, G. B. Bonan, C. W. Bning, S. Bony, H. Bryden, M. A. Cane, J. A. Curry, T. Delworth, A. S. Denning, R. E. Dickinson, K. Echelmeyer, K. Emanuel, G. Flato, I. Fung, M. Geller, P. R. Gent, **S.M. Griffies**, I. Held, A. Henderson-Sellers, A. A. M. Holtslag, F. Hourdin, J. W. Hurrell, V. M. Kattsov, P. D. Killworth, Y. Kushnir, W. G. Large, M. Latif, P. Lemke, M. E. Mann, G. Meehl, U. Mikolajewicz, W. O'Hirok, C. L. Parkinson, A. Payne, A. Pitman, J. Polcher, I. Polyakov, V. Ramaswamy, P. J. Rasch, E. P. Salathe, C. Schr, R. W. Schmitt, T. G. Shepherd, B. J. Soden, R. W. Spencer, P. Taylor, A. Timmermann, K. Y. Vinnikov, M. Visbeck, S. E. Wijffels, and M. Wild. Cambridge, UK: Cambridge University Press, 418-470.

10. **The MOM 3 Manual**, 1999: R. C. Pacanowski and **S.M. Griffies**. NOAA/Geophysical Fluid Dynamics Laboratory Technical Report No. 4. Princeton, USA. 680 pages.

11. Predictability of North Atlantic climate on decadal times scales estimated using a coupled ocean-atmosphere model, 1997: K. Bryan and **S.M. Griffies**. *International WOCE Newsletter*, **26**, 5–9.

12. Predictability of North Atlantic climate variability on multidecadal time scales, 1994: **S.M. Griffies** and K. Bryan. *The Atlantic Climate Change Program, Proceedings from the principal investigators meeting.* NOAA: University Corporation for Atmospheric Research, 77–80.

Theoretical Physics publications

1. Local and Global Aspects of Domain Wall Space-times, 1993: M. Cvetič, **S.M. Griffies**, and H. H. Soleng, *Physical Review* **D 48**, 2613–2634.

2. Nonextreme and Ultraextreme Domain Walls and their Global Space-Times, 1993: M. Cvetič, **S.M. Griffies**, and H. H. Soleng, *Physical Review Letters*, **71**, 670–673.

3. Cauchy Horizons, Thermodynamics and Closed Time-like Curves in Planar Supersymmetric Space-times, 1993: M. Cvetič, R. Davis, **S.M. Griffies**, and H. H. Soleng, *Physical Review Letters*, **70**, 1191–1194.

4. Domain Walls in $N = 1$ Supergravity, 1993: M. Cvetič) and **S.M. Griffies**, 1993: in **The Proceedings of the International Symposium on Black Holes, Membranes, Wormholes, and Superstrings**. (S. Kalara and D. Nanopoulos editors), World Scientific.

5. Nonperturbative Stability of Supergravity and Superstring Vacua, 1993: M. Cvetič, **S.M. Griffies**, and S.-J. Rey), *Nuclear Physics* **B389**, 3–24.

6. Gravitational Effects in Supersymmetric Domain Wall Backgrounds, 1992: M. Cvetič) and **S.M. Griffies**, *Physics Letters* **285B**, 27–34.

7. Static Domain Walls in $N = 1$ Supergravity, 1992: M. Cvetič, **S.M. Griffies**, and S.-J. Rey, *Nuclear Physics* **B381**, 301–328.

8. Two Skyrmion Interaction for the Atiyah-Manton Ansatz, 1990: A. Hosaka, **S.M. Griffies**, M. Oka, and R. D. Amado, *Physics Letters* **251B**, 1–5.